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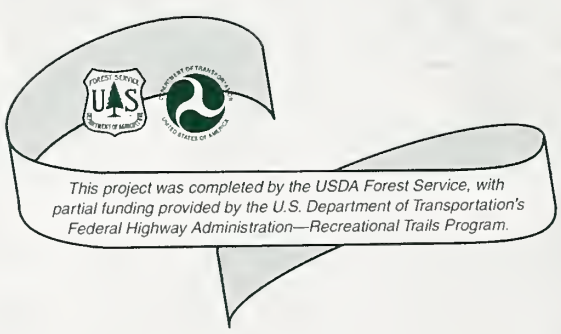
Off-Highway Vehicle Trail and Road Grading Equipment



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Off-Highway Vehicle Trail and Road Grading Equipment

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Technology & Development Program
Missoula, Montana

7E72A49—Grooming Equipment for Cycle Trails

October 1998

Contents

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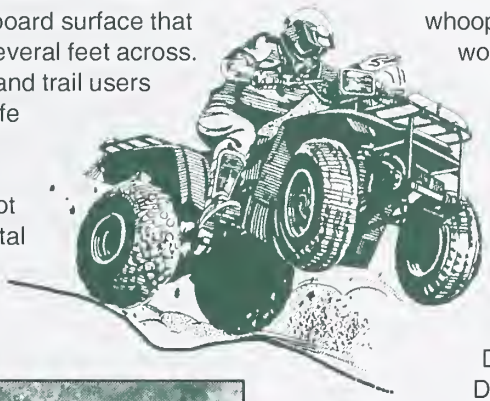
Introduction

The Missoula Technology and Development Center (MTDC) was asked to find a good way to maintain a 40-mile (64-k) motorcycle and all-terrain-vehicle (ATV) trail on the Francis Marion National Forest in coastal South Carolina. Heavy use leaves a washboard surface that progresses to mounds and gullies several feet across. These are called "whoop-de-doos," and trail users find them both unpleasant and unsafe (Figure 1).



The problem of whoop-de-doos is not unique to this trail in the sandy coastal plain of South Carolina. We began the project by asking off-highway vehicle (OHV) trail managers throughout the Forest Service how they were maintaining their OHV trails. Several National Forests had developed prototype lightweight graders that could be towed behind ATV's, effectively removing whoop-de-doos with routine maintenance. MTDC worked with two of these Forests to further improve and evaluate these prototypes, tested them in South Carolina, and looked to the open market for similar equipment.

This report focuses on three pieces of equipment tested in South Carolina: a modified trail rock rake suggested by Cam Lockwood on the Angeles National Forest, CA; a trail drag designed by Dick Dufourd and Kim Larsen for use on the Deschutes National Forest, OR; and an Ultra Light Terrain Grader manufactured by The Shop Industrial, Lively, Ontario, Canada.

Figure 1—Evaluating equipment that effectively cuts the mounds and fills the depressions on washboard trails is what this report is about. This trail has been partly graded to remove the whoop-de-doos.

We found all three pieces of equipment suitable for OHV trails in sandy or pumice soils. They can all be pulled with ATV's. OHV trails are wider, typically at least 4 feet (1.2 m), than hiking or equestrian trails, and have fewer curves. All of the equipment would have functioned better on trails had the equipment been narrower.

The trail rock rake and the Ultra Light Terrain Grader worked exceptionally well on narrow roads like those found in campgrounds, and for grading parking lots. They are a realistic and affordable alternative to full-sized graders for such applications.

In less detail, this report includes other ways that OHV trail managers are maintaining their trails. These include the TrailPlane developed by Mil Lill and used by the Cycle Conservation Club of Michigan; various drags, harrows, cultipackers, and rollers; and other techniques field personnel told us about.

In heavier or rocky soils, on steep trails, and where rutting and erosion is severe, heavier equipment is needed. In these situations, small crawler dozers such as the SWECO 480, small tracked excavators, or small utility tractors do the trick. We give this equipment only cursory coverage in this report. To learn more about this heavier equipment, refer to a 1996 report from the San Dimas Technology and Development Center, *Mechanized Trail Equipment,* 9623-1207-SDTDC. See page 17 to find out how to order a copy. The San Dimas Center is also producing a video about using mechanized trail equipment. It should be completed in 1999.

Equipment Evaluations on the Francis Marion National Forest

This project's objective was to identify equipment that could effectively grade motorcycle and ATV trails in sandy soils. Grooming would smooth out the bumps, flatten mounded berms, and eliminate ruts.

The 40-mile- (64-k)-long Wambaw Cycle Trail is on the Francis Marion National Forest, north of Charleston, SC. It receives heavy use by both motorcyclists and ATV enthusiasts. The topography is flat, the soil is sandy, and the trail winds through mostly pine forest. Curves are tight, designed to appeal to motorcyclists (Figure 2).

The soils and topography presented relatively easy working conditions, so we looked at lightweight equipment that could be pulled by an ATV. Why? ATV's cost less than tractors, and are more widely available on Ranger Districts and through volunteer groups. We wanted to see if this lightweight equipment could do the job.

Figure 2—Typical section of the Wambaw Cycle Trail. The trail was designed for motorcycles, but ATV's are also allowed.

Trail Rake

Cam Lockwood, trail coordinator for the Angeles National Forest in southern California, proposed that MTDC modify a flexible-tooth landscaping rake manufactured by York Modern Company. Lockwood wanted hydraulic controls that would swivel the rake's blade from side to side, raise and lower the wheels for the proper amount of cutting action, and help transport the rake over pavement, rocks, or other obstructions.

We fabricated two prototypes, one for the Angeles National Forest and one for testing on the Francis Marion National Forest (Figure 3). We started with a York Model TA-26, added a hydraulic snowplow power pack, two hydraulic cylinders, a heavy-duty steel battery box, and a gel battery designed to withstand rough treatment. We modified the trailer hitch to accept a $1\frac{7}{8}$-inch (48-mm) ball on an ATV.

The controls raised and lowered the wheels to set the depth of cutting. Adjusting the blade's angle was easy and positive with the hydraulic setup (Figure 4). The hydraulics failed because of a design flaw in the power pack. After talking with the manufacturer, we corrected the problem.

The wheels can be adjusted either to "float" with the terrain, or to be held at different heights, depending on the degree of soil cutting desired. The maximum amount of cutting action is obtained in the float mode.

The rake worked quite well in our limited field tests. The flexible spring-steel tines cut the mounds and filled the depressions in the trail. With the spaces between tines, not as much material was sidecast. To a greater degree than the other two graders tested, the rake pulled berm material back into the middle of the trail (Figure 5), especially with two passes down the trail.

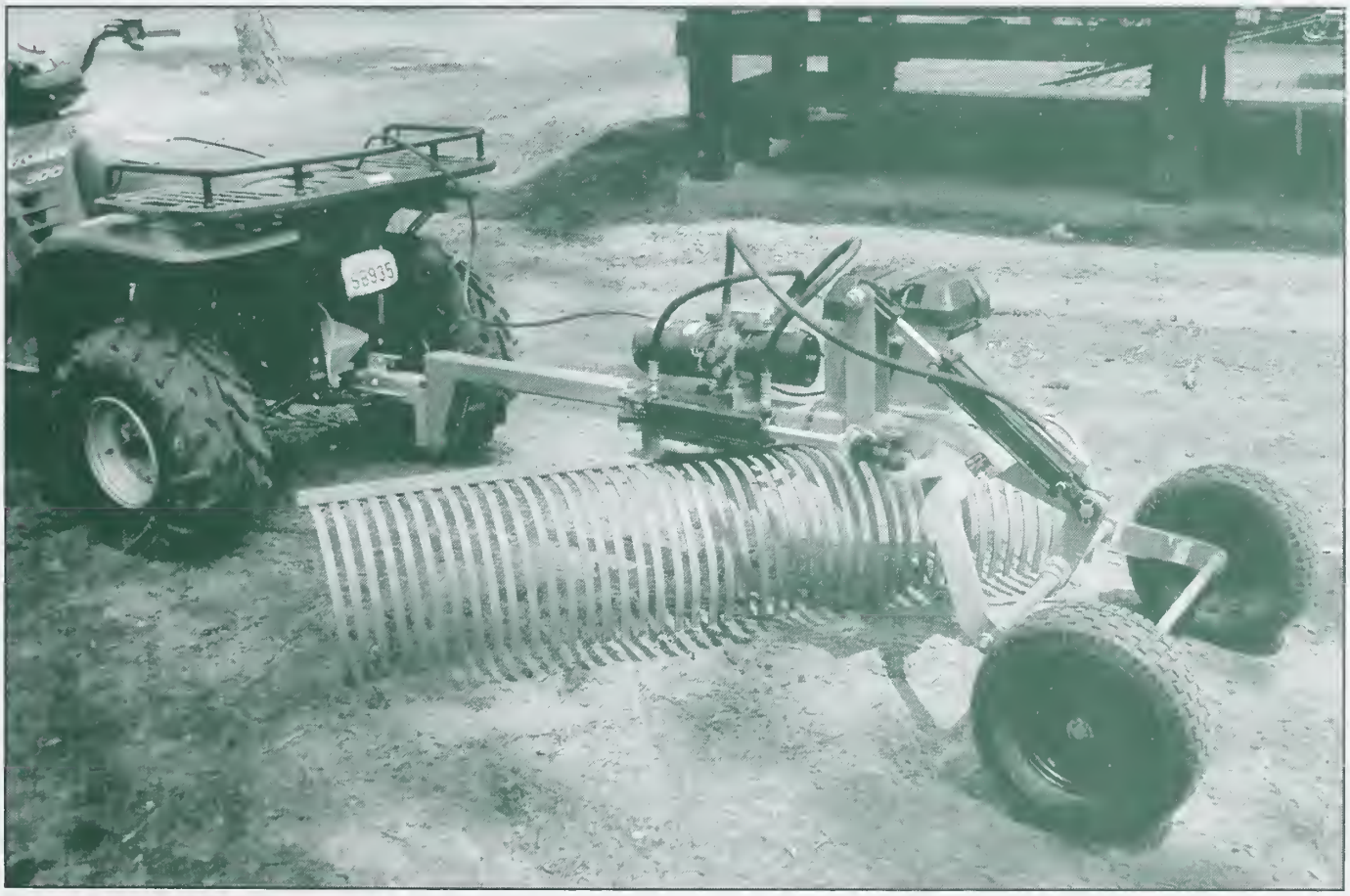


Figure 3—MTDC's trail rake begins with a York landscaping rake, with hydraulics for swiveling the rake and for raising and lowering the wheels.

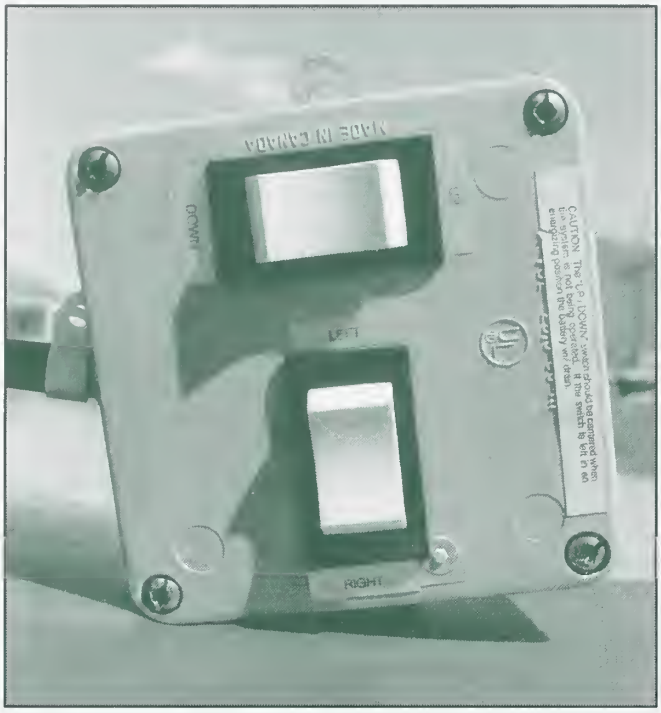


Figure 4—Control switch for the hydraulic power pack angles the rake and raises and lowers the wheels.

Figure 5—With two passes, the trail rake could pull in berm material from both sides to the center of the trail or road. Here, the scraping blade is being used.

For a more positive removal of surface material, the scraping blade is an option (Figure 6). We preferred the action of the rake without the blade, because the rake seemed to roll rocks better than the blade, and there was less bouncing and chance of getting hung up on rocks.

In a third prototype, we have installed ripper teeth into the scraping blade to help loosen compacted tread material, making it easier to rake on subsequent passes when the blade and teeth are raised (Figure 7).

The 6-foot (1.8-m) rake was too wide to maneuver around some of the corners on the Wambaw Cycle Trail. Cam Lockwood thought the width was about right for trails on the Angeles National Forest. The York Rake is also available in a 5-foot (1.5-m) width. This width would have worked better on narrow trails. To keep the benefit of a longer width for road work while allowing the blade to be shortened for the narrow trails, we have hinged each side of the blade in our third prototype.

Parts for the trail rake cost about $2,250. MTDC shop labor added another $1,150, for a total prototype cost of about $3,400.

See page 17 to order engineering construction drawings of the trail rake: *MTDC–968, Trail Rake.* Brian Vachowski or Neal Maier at MTDC can provide additional information regarding alternatives for fabrication, including possible fabrication by MTDC for Forest Service units, depending on MTDC's shop workload.

Deschutes Trail Drag

After experimenting with several different designs over the years, longtime Deschutes National Forest employees Dick Dufourd and Kim Larsen designed a trail drag that grades tread material to the center of the trail. Dick Dufourd reports that it has been working extremely well.

MTDC fabricated another prototype, a wider version of the Deschutes Trail Drag, and tested it in South Carolina. The principal difference was that the MTDC drag was 34 inches (86 cm) wide (Figure 8). For trail work, we found it was a mistake to widen the drag from its original 28 inches (71 cm). The extra width made it more difficult to wind around trees and curves in the trail. This, of course, would be more of a problem on some trails than on others.

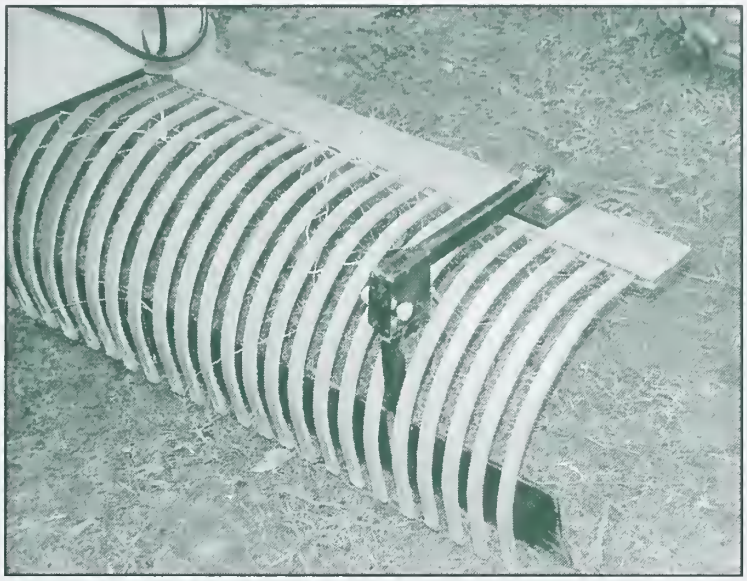


Figure 6—The scraping blade flips up out of the way when not in use.

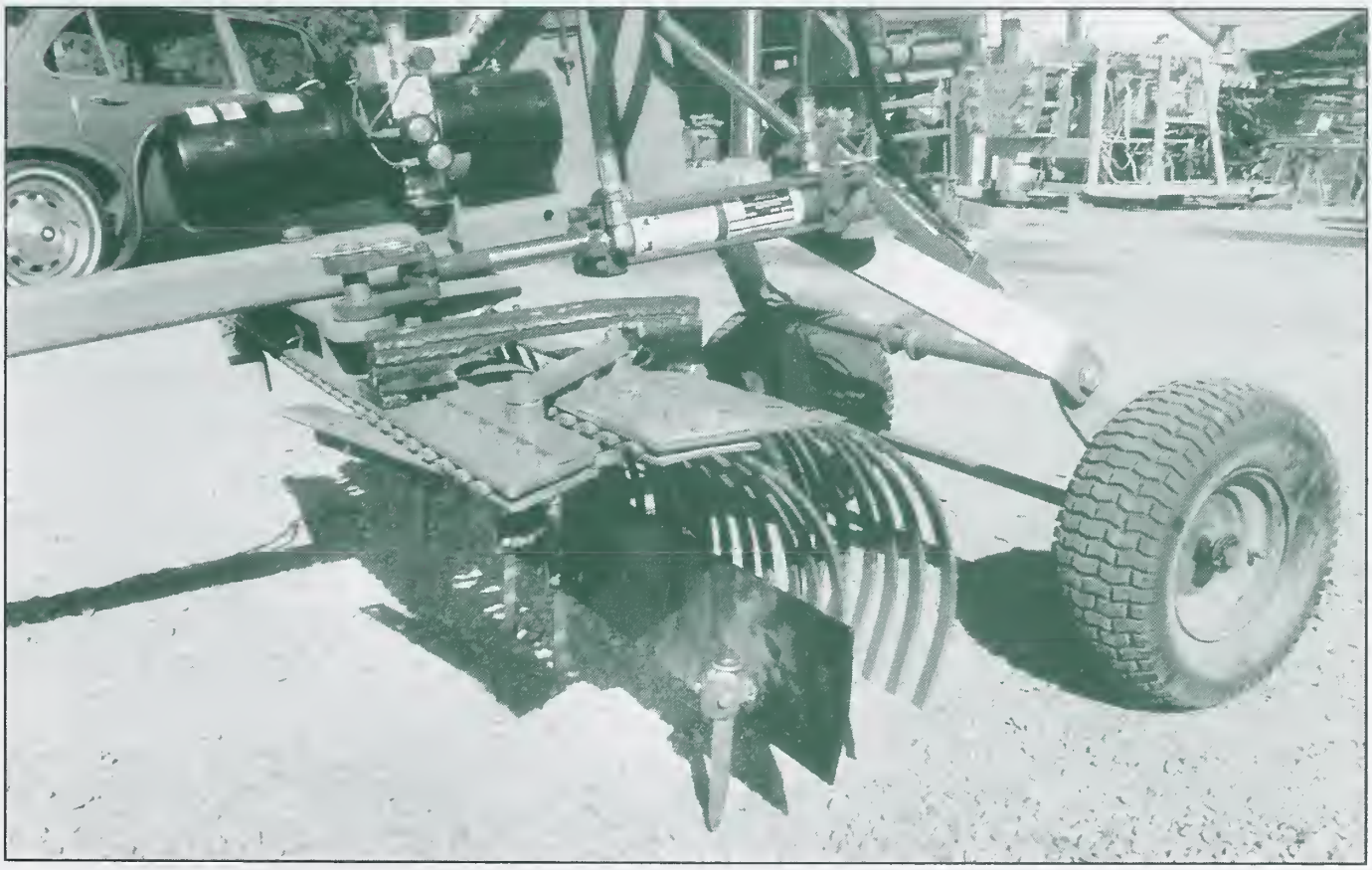


Figure 7—Ripper teeth attached to the scraping blade in an untested third prototype. The ends of the 6-foot (1.8-m) rake were hinged (center) to narrow the rake for trails and widen it for roads.

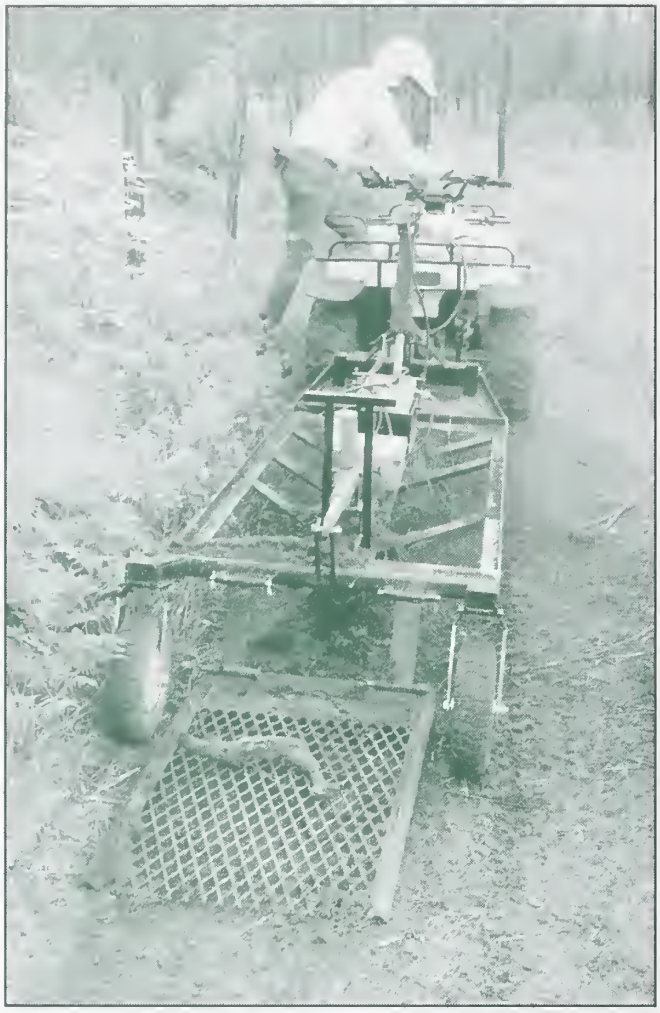


Figure 8—MTDC's version of the Deschutes Trail Drag. The original was only 28 inches (71 cm) wide, a better width for trails than this one, which is 34 inches (86 cm) wide. Angled blades on the drag provide a cutting action, pulling in loose tread material to the center of the trail. A straight blade on the rear, and a beavertail metal grate behind the rear wheels, smooth out the graded material.

An electric actuator, controlled by the ATV operator, raises and lowers the wheels to control the amount of soil cutting.

In South Carolina, the Deschutes Drag effectively flattened the washboarded whoop-de-doos. However, the actuator that operates the wheels failed. We were unable to make the number of passes down the trail needed to smooth it completely. The Deschutes National Forest, working in pumice soil, reports that their version of the drag works fine in removing whoop-de-doos, and that usually about three to four passes are needed to grade the trail smooth. They, too, reported actuator problems. Our engineering plans now specify a heavy-duty actuator that should correct the problem.

If you would like to build the Deschutes Trail Drag, contact MTDC and ask for Engineering Drawing *MTDC–969, Deschutes Trail Drag*. Call Brian Vachowski or Neal Maier to talk about fabrication questions.

Parts for the Deschutes Trail Drag cost about $1,050. Labor is estimated at $1,400, for a total cost of $2,450 for our prototype.

Ultra Light Terrain Grader

A commercially available product, the Terra Master ULTG 12-04 Ultra Light Terrain Grader, was the third piece of equipment we evaluated in South Carolina. It is manufactured by The Shop Industrial, Lively, Ontario, Canada (Figure 9).

The Ultra Light Terrain Grader is based on the successful design of the The Shop Industrial's Mogul Master line of snowmobile trail groomers (Figure 10). Its long planing length and grader blades produce a smooth and very flat surface after several passes down the trail. Each rear wheel is independently adjusted manually for the degree of cutting desired, as well as to adjust the slope of the finished grade. Usually, the wheels have to be adjusted only infrequently. Outslope or crowning is possible with this machine.

The Ultra Light Trail Grader is designed to be pulled with a four-wheel drive ATV or similar vehicle. The grader's cutting depth and load are controlled by the operator. A handlebar control switch activates an electric actuator that is mounted between the hitch and main frame of the grader.

The Shop Industrial markets the Ultra Light Terrain Grader for use on ATV and dirt bike trails, bicycle paths, roads, parking lots, and driveways, for landscaping, or for any application where the terrain needs to have a smooth, flat finish.

Ultra Light Terrain Grader Specifications

Width: 4 feet 3 inches (1.3 m)
Length: 14 feet (4.3 m)
Height: 25 inches (64 cm)
Weight: 450 pounds (204 kg)
Four heat-treated serrated grader blades
One rear heat-treated straight grader blade
Eight-inch (20-cm) stroke, 12-volt electric actuator
Front hitch with 1⅞-inch (48-mm) trailer ball receiver
Control switch and wiring harness
Dual rear wheels with manual "top link" adjusters.

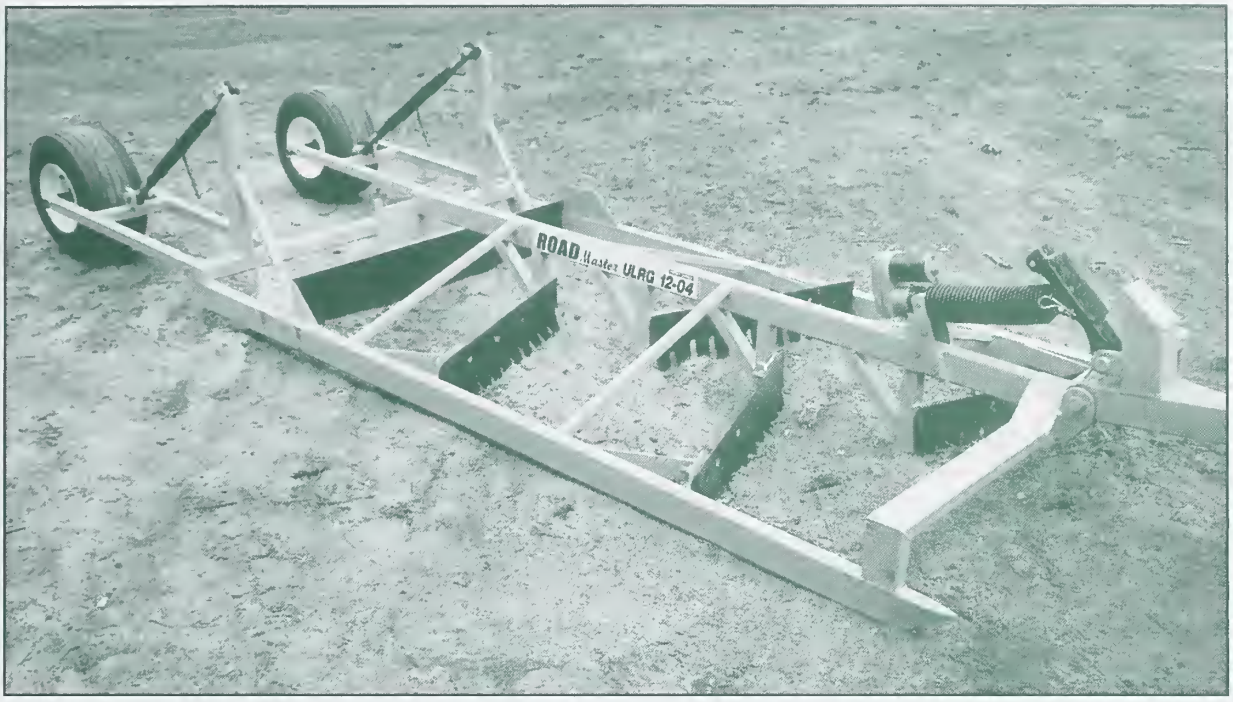


Figure 9—The Ultra Light Terrain Grader has manually adjustable rear wheels and an electrically operated front lift.

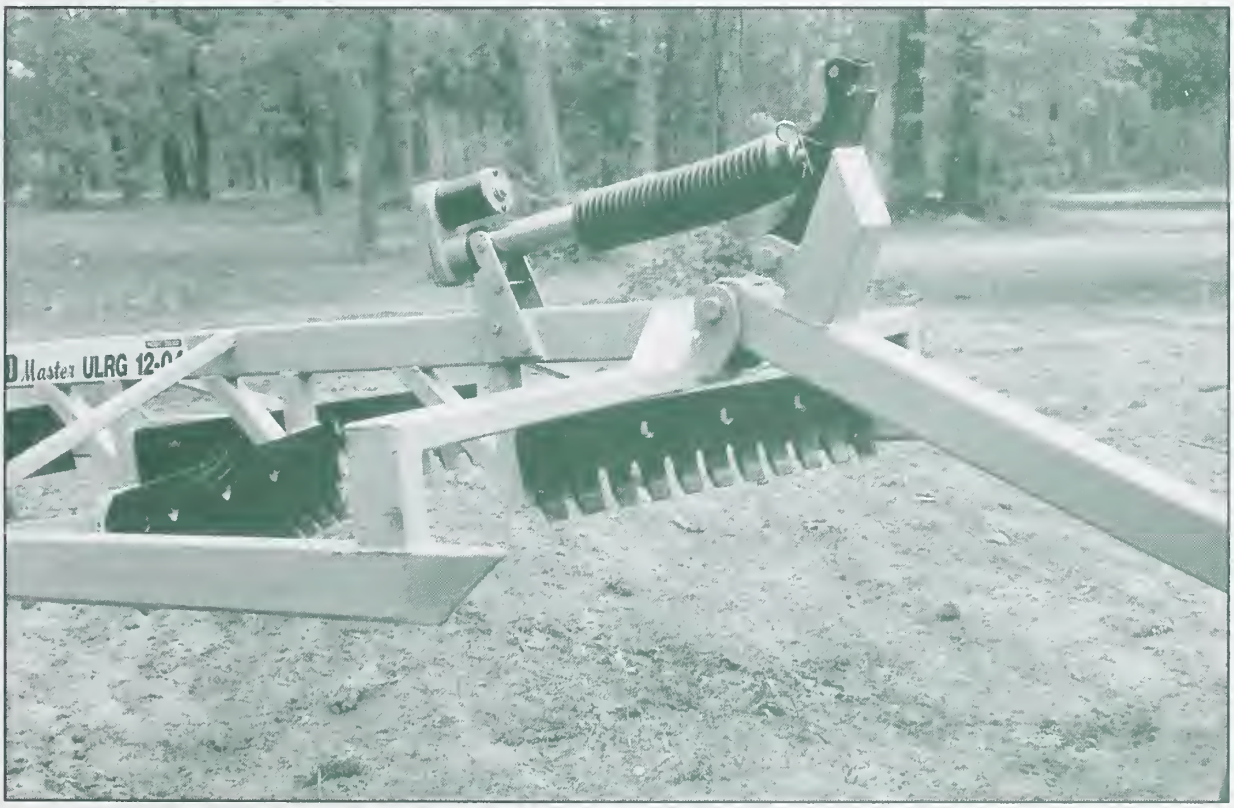


Figure 10—An electric actuator on the Ultra Light Terrain Grader lifts the front end to the desired level, setting the depth. Four angled serrated grader blades plus a rear straight grader blade pull soil to the center of the trail.

The 1998 price for the Ultra Light Terrain Grader was $2,750 (U.S.), FOB Lively, Ontario, Canada. Customs' and brokers' fees are included in the price. The Ultra Light Terrain Grader is the only grader in The Shop Industrial's line that can be pulled with an ATV. The company has two other models 6 feet 4 inches (1.9 m) wide, and 8 feet 4 inches (2.5 m) wide that can be pulled with a pickup truck. They are designed for road and lane grading. See page 17 for information about contacting The Shop Industrial.

Figure 11—Due to its length and width, the Ultra Light Terrain Grader had a hard time negotiating corners.

The Ultra Light Terrain Grader (Figure 11) was too wide and long to negotiate many of the curves in this particular trail without widening the trail or hitting trailside trees. We limited the evaluation to a section of trail with gradual curves and fewer trees close to it (Figure 12). The Shop Industrial representatives said they would be willing to custom build shorter and narrower versions of the Ultra Light Terrain Grader that might be better suited for trail work.

On roads and parking lots, the Ultra Light Terrain Grader was very effective (Figure 13). Where larger graders are not

Figure 12—In the South Carolina demonstration, the Ultra Light Terrain Grader was very effective in removing whoop-de-doos after several passes down the trail.

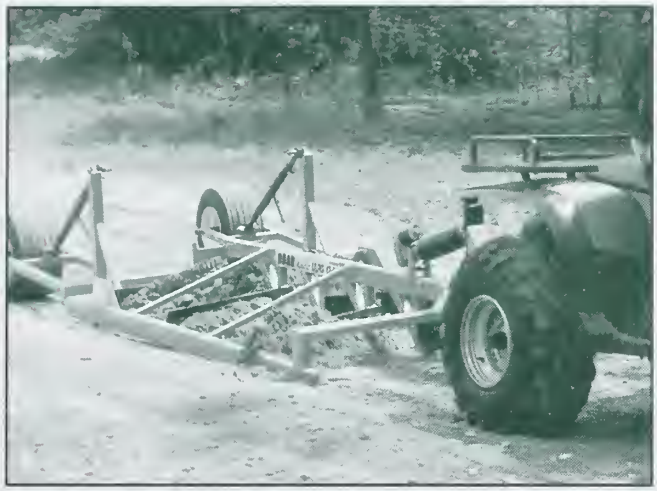


Figure 13—The Ultra Light Terrain Grader was designed for roads and parking lots. It works best there.

available when you need them, or on narrow roads, driveways, and in campgrounds, the Ultra Light Terrain Grader may be a good choice.

Summary of South Carolina Field Evaluations

All three graders effectively graded parts of the Wambaw Cycle Trail. None of the graders completed the task in a single pass. Graders required three or four passes to completely remove whoop-de-doos.

All three graders were too wide for this particular trail, and would be too wide for most motorcycle trails and some ATV trails in forested settings. The equipment is also too wide for hiking and equestrian trails. The problem was that the graders had a hard time negotiating corners and avoiding trailside trees. The graders tended to track the *inside* corner of turns, but the tread material that need-ed to be brought back onto the trail was bermed along the *outside* edge. The graders worked best on straight sections of trail and on trails with gradual curves.

Frequent curves are designed into these trails to differentiate them from roads and to make them fun to ride. Straightening or widening trails to make them easier to maintain could reduce user satisfaction. Trails would become B-O-R-I-N-G.

Although the graders are designed to pull tread material back onto the trail from the edges, none of the three graders could reach more than a few inches beyond the edges of the trail to pull in bermed material. The Trail Rake was a little better than the others. Depending on the amount of tread that had been eroded or cast off the trail, the graded trailbed was lower than surrounding terrain. Although this wasn't a problem in the porous, sandy soil of coastal South Carolina, creating such a trench in the heavier soils or in erosion-prone areas would cause water to run down the trail or to pool.

The best solution for severely eroded trails is to bring in additional clean, structural fill material (from the berms or somewhere else), raising the tread surface to grade. Effective drainage structures would need to be installed to move water off the trail. You will want to assess whether such a solution, with regular maintenance, is going to be permanent. If not, consider closing and restoring that trail segment if a better route can be found.

In soft soils, it's best to keep users off the trail after grooming. The longer, the better. One day is better than none, and a week is better yet. "Setting up" depends on soil moisture. Some of the loops on the South Carolina cycle trail are closed for an entire season to allow rainfall to "set up" the trail, forming a hard, compacted surface.

An unexpected surprise! Although the graders we evaluated were a little too wide for the Wambaw Cycle Trail, the Trail Rake and the Ultra Light Terrain Grader were the cat's meow when it came to grading roads and parking lots (Figure 14, next page). Your nearest full-size grader may be 50 miles or 2 months away, but your cooperating OHV club can be there tomorrow and get the job done before the Big Event. These ATV-pulled graders are reasonable alternatives for light-duty road work at campground roads and spurs and at parking lots. They also have good potential for roads-to-trails conversions and in rails-to-trails programs.

ATV Power Requirements

Pulling these graders is tough on ATV's, especially when rocks or roots are encountered. We noticed a direct correlation between happiness and horsepower when it comes to trail grading. More horsepower means fewer overheated engines, less cussing, more work getting done.

For the South Carolina evaluations, The Shop Industrial brought a 500-cc Polaris Sportsman to test their grader (Figure 14).

At the East Fort Rock OHV areas on the Deschutes National Forest, 500-cc Polaris machines are also used. They are four stroke, four-wheel drive, and liquid cooled. The vehicles are always operated in low 4-by-4 range. The graders perform best at slow speeds, 5 to 7 mph (8 to 11 k/hr)—they cut better and bounce less. Appendix A includes an equipment checklist, and Appendix B shows the trail-grooming procedures for the East Fort Rock OHV trails.

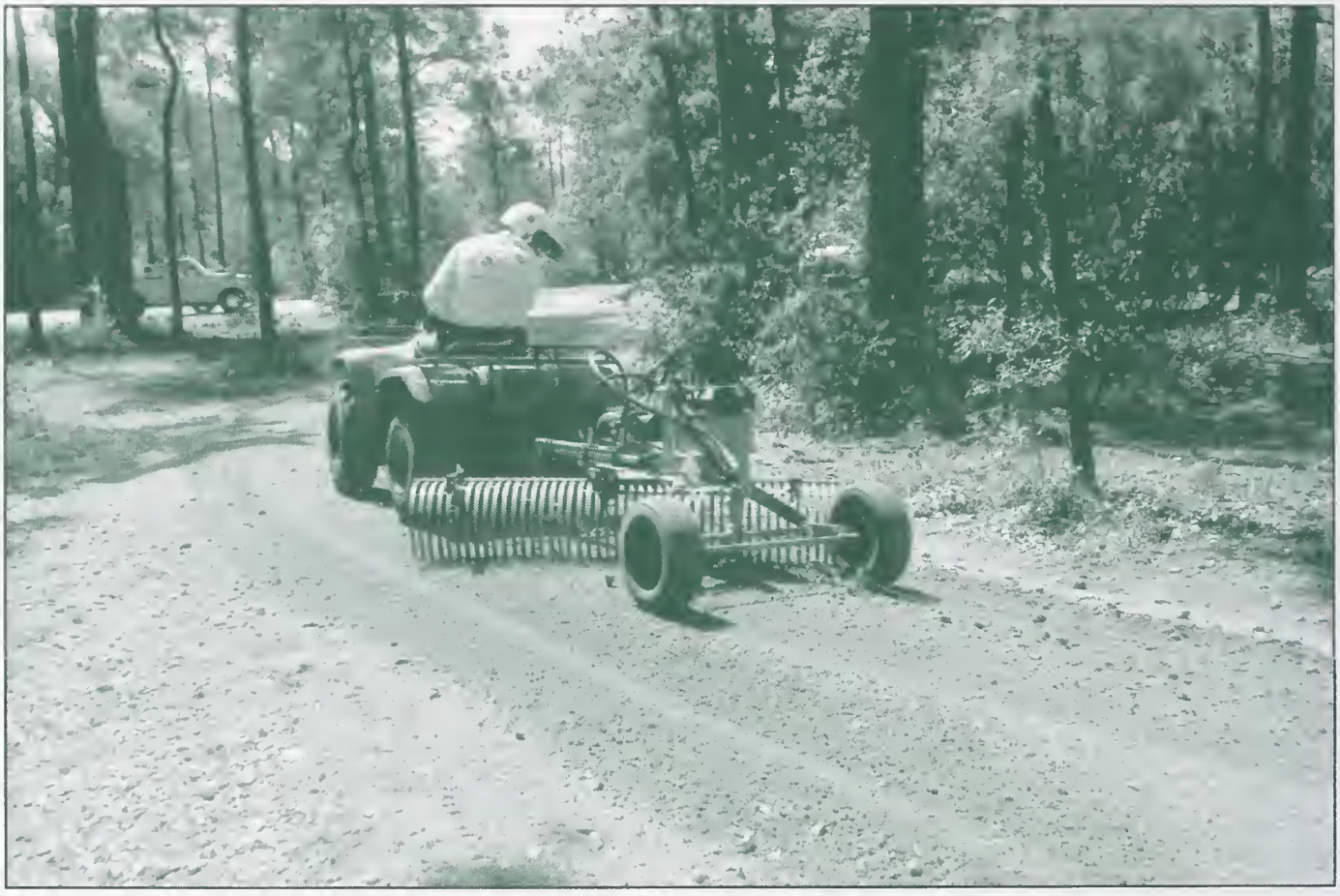


Figure 14—The trail rake and Ultra Light Terrain Grader worked great on campgound roads and parking lots.

Other Trail Grading Equipment You Can Pull With an ATV

Our field contacts provided information about several other techniques and equipment they had tried or were using for OHV trail maintenance. Here are some grading accessories you can tow with an ATV.

Tine Harrow

The tine harrow (Figure 15) is best used for finish work, smoothing the trail surface once it has been leveled by other means. It has smoothing power but not much cutting power. It does not provide any compaction.

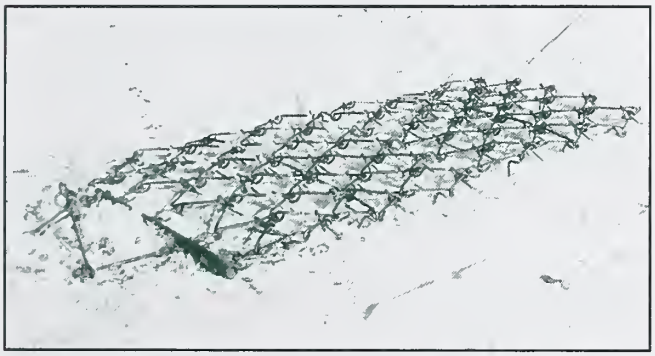


Figure 15—The tine harrow or pasture drag can be pulled with the tines down for scarification, or the harrow can be flipped over for final smoothing.

Tire Drags

Old truck tires (Figure 16) can be filled with concrete for added weight. Large truck tires are heavy enough without extra weight. Tires, sometimes one behind another, are inexpensive and help to smooth the trail surface. They have little cutting ability to remove whoop-de-doos, and also push tread-surfacing material to the sides of the trail—a disadvantage.

We also heard about using three tire halves (cut like you would slice a bagel, using a reciprocating saw), bolted together in a triangle and dragged with the cut face down.

Figure 16—Tire drags with various configurations of one, two, or three tires help to provide a smooth, finished surface to the trail.

Dixie National Forest Drags

Ralph Rawlinson sent information of good success with two inexpensive drags used on the Dixie National Forest in Utah. Both can be pulled with ATV's. The base of the rectangular drag (Figure 17) is 5 feet 8 inches (1.8 m) long, and 4 feet (1.2 m) wide. The perimeter is 3-inch (7.6-cm) angle iron, the middle bar is 3-inch (7.6-cm) channel iron.

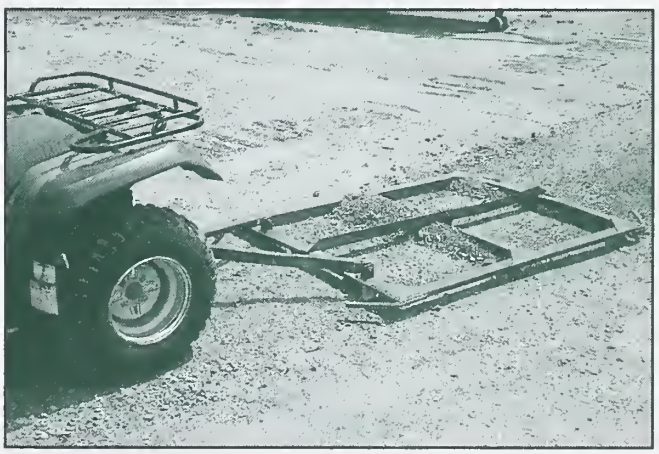


Figure 17—This rectangular drag from the Dixie National Forest is inexpensive and effective.

The V-Drag

The V-Drag (Figure 18) is basically fabricated out of two 67-inch (170-cm) pieces of 4-inch (10-cm) channel iron. It is 54 inches (137-cm) wide. This design sidecasts the trail material rather than pulling it into the center, an undesirable feature.

Figure 18—The V-shaped drag moves material to the side of the trail, a disadvantage.

Perpendicular Cutting Drag

Another grader prototype from the Deschutes National Forest features cutting blades perpendicular to the trail instead of angled (Figure 19). This particular configuration left a small berm of material on either side of the grader. When a pass with the perpendicular cutting drag was followed by a pass with the Deschutes Trail Drag, and then a pass with the tine harrow, trails were left in good shape. Dick Dufourd does not plan to build another perpendicular cutting drag. The Deschutes Trail Drag, with its angled blades and electric actuator, is far superior.

Figure 19—Early prototype of a drag with cutting blades perpendicular to the trail. It needs significant changes to make it work better.

Roller

This basic lawn roller (Figure 20) can be pulled by an ATV. It smooths the surface but provides no compaction. We do not recommend it for trail maintenance.

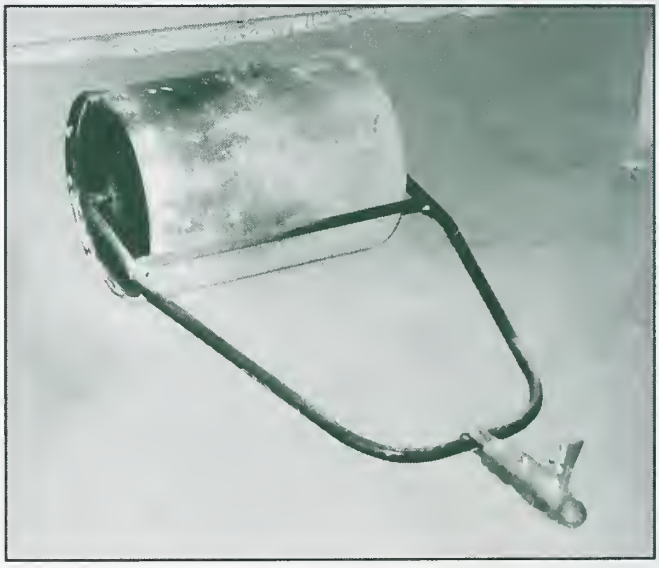


Figure 20—This garden variety lawn roller did not provide enough benefit to make it worthwhile for trail grooming. Pulling it is a waste of time.

Heavy-Duty Trail Grading Equipment and Accessories

For many trail jobs, an ATV is not powerful enough. Larger equipment is needed. A number of small utility tractors, crawler tractors, and excavators (Figures 21 and 22) have enough power to handle these larger jobs.

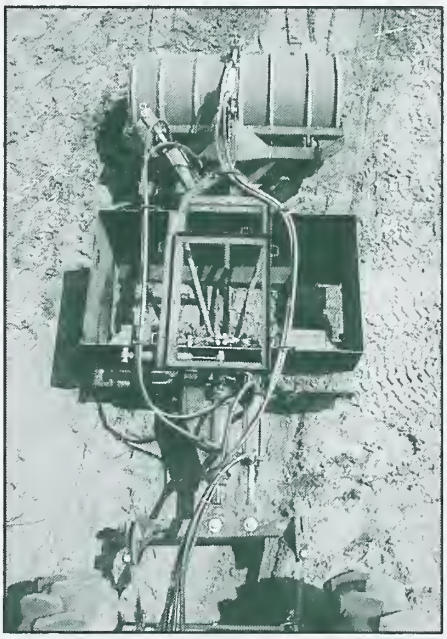
The almost unlimited number of accessories for these machines goes beyond the scope of this report. They include dozer blades, rototillers, rippers, and backhoes. However, a few accessories relate specifically to trail grading.

Figure 21—The SWECO 450 light crawler dozer has been upgraded to the 480 model.

Figure 22—Utility tractors are very versatile and useful for heavy-duty trail work.

TrailPlane

The most elaborate trail grader brought to our attention was one developed by Mel Lill for the Cycle Conservation Club of Michigan. A wider version based on modifications of this design was fabricated by the Michigan Department of Natural Resources' Forest Fire Experiment Station (Figures 23a and 23b). The TrailPlane consists of a hydraulically operated box scraper followed by a 350-pound (158-kg) roller. The roller pivots behind the box scraper, steered hydraulically to follow in the tracks of the tractor around tight turns.



Figures 23a and 23b—Mel Lill's TrailPlane, shown as modified by the Michigan Department of Natural Resources (photo by Michigan DNR).

Figure 23b.

Michigan has an extensive system of OHV trails. Most of the trails originated as motorcycle paths specified to be 24 inches (60 cm) wide on the ground and 40 inches (102 cm) clear at handlebar height. Michigan's soil is generally light and sandy. Under heavy use, OHV trails tend to form whoop-de-doos. With the increasing numbers of ATV's, many trails have been widened to 50 inches (127 cm) clear from the ground up. To a large extent, they retain the tight turns and steep slopes of the original paths.

The Cycle Conservation Club of Michigan is a user group with great involvement in developing and maintaining OHV trails. When funds became available from OHV license fees, club chapters under contract with the Michigan Department of Natural Resources developed and marked many more loops and connecting trails.

By 1989, it became apparent that the whoop-de-doos were a threat to the future of the trail system. Club members began developing trail-grading equipment suited to Michigan. To meet the specifications for motorcycle trails, they chose a compact diesel four-wheel-drive tractor under 40 inches (102 cm) wide and built a grader box and roller that were just 24 inches (61 cm) wide. The grader box is carried between a centerpoint hitch on the lower links of the tractor and a ballast-filled roller in the back. The box has a cutter blade in front as well as a scraper blade in back. The box is suspended like a landplane between the back wheels of the tractor and the rear roller. When the tractor and the roller drop down into hollows in the trail, the grader box cuts into the hump between them. The roller is also steered by a master cylinder-slave cylinder system so that it follows in the tracks of the tractor around tight turns. The complete machine is called a TrailPlane.

In addition to the original 24-inch (61-cm) TrailPlane, the club has developed a 39-inch (99-cm) unit pulled by a 43-inch (109-cm)-wide tractor for motorcycle trails that have begun to be used by small ATV's. For trails that have been officially widened for 50-inch (127-cm) ATV's, the Michigan Department of Natural Resources Forest Fire Experiment Station built a 46-inch (117-cm)-wide unit.

The Michigan DNR's version (Figures 23a and 23b) is towed by a four-wheel-drive Ford Model 1715 tractor. This tractor was selected because it provided the most power for tractors that could be reduced to a width of about 50 inches (127 m) wide. A front-mounted electric winch and limb risers were added to the tractor.

The DNR's system consists of a box grader, followed by a roller. The box grader is coupled to the tractor's three-point hitch with a torsion dampener arm. Adjustable root cutters are located on the box's front corners. An operator-controlled hydraulic cylinder above the roller changes the box grader attack angle. Depth of cut is controlled by setting the hitch height. The minimum inside turning radius of the system is 48 inches (122 cm). The system's path width is 68¼ inches (2 m) for that turning radius.

On the trail, each TrailPlane requires a helper on an OHV (usually a motorcycle) to scout ahead for blowdowns and other obstacles. The helper can trim brush, replace signs, and assist the operator if the tractor gets stuck. Speeds average about 4 miles per hour (6.4 kilometers per hour).

Trail grading is always done in round trips, giving the trail at least two passes as the TrailPlane returns to the unloading point. The worst whoop-de-doos cannot be completely cut down in two passes. In such cases, the unit is turned around in the woods to give them extra passes. The best grooming is often done late in the fall, allowing the graded trailbed to consolidate over the winter.

The TrailPlane does not disturb the trailbed below the average grade, so it minimizes areas of deep loose sand, found frequently on Michigan's snowmobile trails that are leveled with road-grading equipment.

Cultipacker

The cultipacker (Figure 24), used in agricultural applications, was too heavy to be pulled by an ATV. It can be used with a tractor such as the SWECO 480. It can push small rocks down into the trail tread, and breaks up highly fractured or soft rocks. It provides very little compaction.

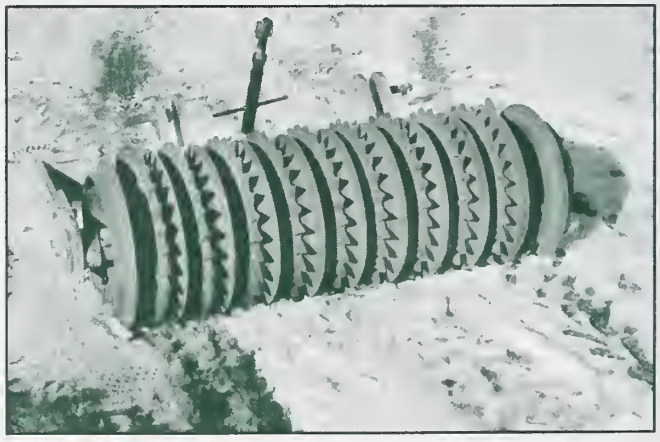


Figure 24—The cultipacker does not rate as a "must have" trail implement.

Box Scraper

Landscaping box scrapers (Figure 25) generally are too heavy to be pulled by an ATV, but can be pulled with a small tractor. With a skilled operator and several passes up and down the trail, the box scraper does a good job of leveling whoop-de-doos. Cutting the mounds and filling the depressions does not happen automatically as the machine goes down the trail. Constant monitoring and adjustments by the operator and frequent back-and-forth motions are needed.

Figure 25—This box scraper, cut down to a width of 3 feet (0.9 m), does a good job of removing whoop-de-doos, but requires a skilled operator and a tractor.

Rock Rake

A rock rake (Figure 26) cut down to a width of 3 feet (0.9 m) and mounted on a utility tractor worked well on the Wambaw Cycle Trail.

Heavy-Duty Drag

A John Deere 855 four-wheel-drive tractor pulls this heavy-duty drag (Figure 27) on straighter trails in open country on the East Fort Rock OHV area. Its weight and aggressive cutting action were too much for an ATV to handle, but it

Figure 26—A 3-foot (0.9-m) rock rake proved to be another good tractor accessory.

provides fast and excellent grooming when pulled behind the tractor. A tine harrow can be attached behind the heavy-duty drag for a smooth finished trail.

Figure 27—Dick Dufourd inspects "Big Bertha." Its aggressive cutting action and weight are too much for an ATV to handle, but it works great in sandy soil when towed by a tractor.

Vibratory Roller

A compacted, groomed trail will last two to three times longer than one that has not been compacted. Dick Dufourd has found that a tandem drum vibratory roller (Figure 28) works best for compaction. The process is slow, and there must be adequate soil moisture for it to work well.

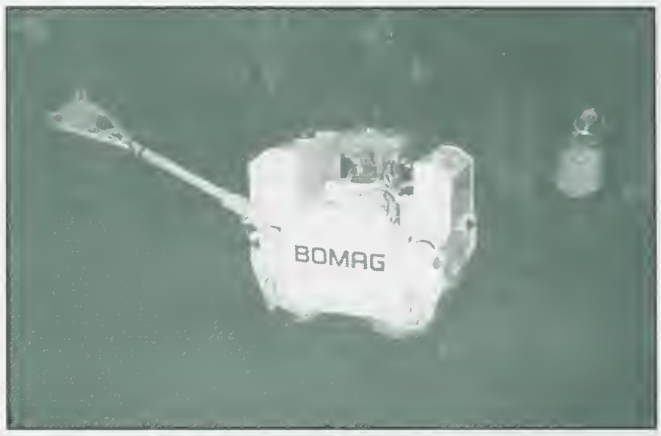


Figure 28—This Bomag walk-behind vibratory roller provides excellent compaction but is slow.

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- MTDC engineering drawings: *MTDC-968, Trail Rake;* and *MTDC-969, Deschutes Trail Drag:*
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- San Dimas Technology and Development Center's publication, *Mechanized Trail Equipment* (9623-1207-SDTDC):
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Brian Vachowski is a Project Leader specializing in recreation, trails, and wilderness projects at Missoula Technology and Development Center since 1993. He received a bachelor's of science degree in forestry from the University of Massachusetts in 1974 and a master's of science degree in outdoor recreation from Utah State University in 1976. He has worked for the Nez Perce, Bighorn, Winema, and Routt National Forests. Before coming to MTDC he was an assistant staff officer for wilderness and recreation on the Nez Perce National Forest.

Neal Maier has been MTDC's shop supervisor since 1997. He began working at the shop in 1976 as a mechanical engineering technician. His Forest Service career started in 1966 in cartography for the Northern Regional Office at Fort Missoula. He later worked in the printing shop at Fort Missoula, and the duplicating shop in the Regional Office where he was shop supervisor. He was office services supervisor in the Regional Office before coming to MTDC.

Appendix A—Equipment Checklist for the East Fort Rock OHV Area

EQUIPMENT CHECKLIST

Equipment Make/Model:_____

Operator:_____ Date:_____

In an effort to keep the equipment maintained, serviceable, and safe, operators should do a pre-ride and post-ride inspection and make a note of items that are loose, broken, malfunctioning, strange noises, etc. Except for tightening loose bolts before they fall off or obvious preventative maintenance, DO NOT make any adjustments or repairs to the equipment—especially carburetor, electronics, and transmission.

The following items should be checked daily:

- **ATV/Motorcycle**

Pre	Post		Remarks
____	____	Injector oil level (if applicable) or engine oil	_____
____	____	Coolant level	_____
____	____	Proper tire pressure (ATV 3-5 psi), and rim condition	_____
____	____	Smooth, efficient operation of throttle and brake levers	_____
____	____	Steering and suspension	_____
____	____	Brake operation	_____
____	____	Parking brake operation	_____
____	____	Chain tension and drive train	_____
____	____	Headlights, brake lights, and indicator lights	_____

- **Trailer and miscellaneous equipment**

Pre	Post		Remarks
____	____	Tire pressure and wear	_____
____	____	Bent axles, fenders	_____
____	____	Spare tire	_____
____	____	Trailer lights	_____
____	____	Worn or broken tie-downs	_____

- **Drags or other equipment**

Pre	Post		Remarks
____	____	Loose bolts	_____
____	____	Loose or broken couplers	_____
____	____	Broken welds or cutting edges	_____
____	____	Loose or broken electronics	_____

NOTES:_____

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Appendix B—Trail Grooming Procedures for the East Fort Rock OHV Area

TRAIL GROOMING PROCEDURES

Trail grooming is a critical part of East Fort Rock trail maintenance. Due to our soft soils, moguls develop very rapidly. Once they reach a certain depth, not only is riders' experience decreased, but they will ride the edges of the trail and control of trail width is lost. Regular grooming will slow the development of the moguls and reduce the interval between reconstructions.

Equipment

- Fill out the Equipment Checklist before and after operating equipment.
- All quads use premium unleaded fuel.
- All quads must be operated in **4WD LOW RANGE** when dragging.
- The most effective combination to date is to groom with three drags in the following order:
  First—grader bit, cutting bit, or other hard drag
  Second—electric hard drag
  Third—pasture drag (tine harrow)
- The objective is to move dirt, not make time. The most effective speed is about **3 to 5 mph** with a maximum speed of 7 mph. **Any faster than this will reduce effectiveness and tear up the equipment.**
- Dragging is tough on the equipment—if the quads get hot, stop and let them cool off.
- The Polaris quads are belt-driven. If a belt gets excessively worn, stretched, or burned, the quad will lose power, vibrate, or get very hot (or all three). To prevent this:
  –Engage the throttle gradually. Do not "grab a handful" or drag race.
  –Operate in **4WD LOW RANGE** when dragging.
  –Be sure the parking brake is off before accelerating.
  –If the drag gets hung up on a rock or stump, do not "gas" it to try to dislodge it. This can seriously burn the belt.
- **Do not** operate the quads with the headlights on, especially if towing the electric drags. It will drain the batteries.
- It is best to run four quads together so that the last one can help lift the pasture drag over obstacles or remove large rocks that are rolled up and may become a hazard.

Grooming Techniques

- Do not drag across gravel or paved roads. Raise the drags before getting to the road so that material is not deposited in the road. Creating a groove or leaving material in the road could become a liability concern. If there are extra people for rakers, rake in the groove in all nonpaved roads.
- Do not drag across cattle guards or grates, especially those used as trail counters. Raise drags before reaching cattle guard so there is not a mound before or in the cattle guard. Take a reading of trail counters before and after crossing.
- Drag slowly. Keep an eye on how well the drags are working and do not overwork the quads.
- Adjust the tongue and wheels so that material is cut off the top and deposited in the bottom of the moguls. The wheels on the electric drags should be down a little at all times.
- Raise the drags when crossing rocky or cobble areas to avoid damage to the drags.
- We do not want to over-maintain the trail. We want a trail experience, not a highway experience. It is important not to alter the intended difficulty level of the trail. Rocks add difficulty and interest to a trail, do not remove all of the rocks (or any of the rocks in some trails), only a rock that creates an unusual or unexpected hazard.
- If a rock or stick gets caught in a drag, stop and remove it so that a groove is not made in the trail, or equipment gets damaged.
- Avoid turning around and raise the drags if turning is necessary. Turning with the drags down can create a confusing "spur" for the riders and you may unknowingly be impacting a sensitive plant or cultural site.
- Your work is important and will be appreciated by hundreds of riders. Take the time and effort to do it right and be proud of what you've done.
- Just in case no one else says it: ***Thanks for your help!***

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Library Card

Vachowski, Brian; Maier, Neal. 1998. Off-highway vehicle trail and road grading equipment. Tech. Rep. 9823-2837-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 20 p.

Describes light-duty grading equipment that can be pulled by an all-terrain vehicle to maintain wide trails and roads. Three pieces of equipment were tested on a sandy motorcycle trail and a trailhead access road in the Francis Marion National Forest in South Carolina: a modified trail rock rake, a trail drag, and a commercial product, the Ultra Light Terrain Grader. All three pieces of equipment removed the washboarded "whoop-de-doos" in the sandy soil. Narrower equipment would have worked better on trails. The equipment worked very well on roads and offers an affordable alternative to heavier graders for light-duty use. Other trail-grading accessories and drags for small tractors are also described.

Keywords: all-terrain vehicles, ATV, forest trails, OHV, trail maintenance

Additional single copies of this document may be ordered from:

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